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Some reflections on *Hymenolepis furcifera* Krabbe 1869 and related species

Rozważania nad *Hymenolepis furcifera* Krabbe 1869 i gatunkami pokrewnymi

Subjects of study were detailed analyses of species *Hymenolepis furcifera* Krabbe 1869 and of some „species" related, based on my close knowledge of *H. furcifera.*

The material for present study I collected in the Mamry Lake (northern Poland) in 1956 and 1957. I have examined 68 specimens of *Podiceps cristatus* L. and 4 *Podiceps griseigena* Bodd. during this two year period. 49 birds, or 68 per cent, out of the total of 72 examined individuals were infested with *H. furcifera.* In my study I applied methods described by Wiśniewski et collab. 1958. By measuring the tapeworms shortly after death I was able to establish correctly their proper body dimensions. The tapeworms, kept in normal well or lake water, were fixed and stained with milk acid carmine after measuring and checking their degree of maturity was completed. The material thus obtained consisted of 1,426 specimens of *H. furcifera* which allowed a through examination of the anatomical structure and enabled me to make several observations concerning the formation and differentiation of *H. furcifera* population structure.

Description of *Hymenolepis furcifera* Krabbe 1869 from *Podiceps cristatus* L. cought in Mamry Lake.

Strobila of *H. furcifera* is thin and filiform in shape; it slightly widens posteriorly. Its maximal length in specimens found in *Podiceps cristatus* L. considerably exceeds the length quoted hitherto,

reaching up to 507 mm, with 350 mm on the average. It should be strassed that such a considerable mean length of the worms was never noted in *Pediceps griseigena* the parasites averaging 200 mm in length. *Podiceps cristatus* may be supposed to be, most probably, the proper typical host the intensity and extent of infestation being

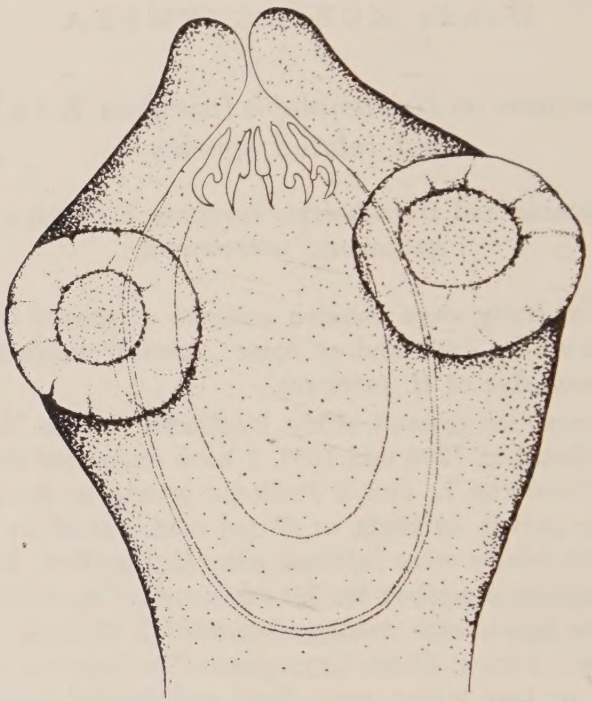

Fig. 1. *Hymenolepis furcifera* Krabbe — scolex with proboscis turned inside

the highest in this particular species while *Podiceps griseigena* and *Podiceps nigricollis* (Linstow 1908) are less typical and therefore the worms parasiting on them are less in body dimensions.

The strobila is composed of several hundreds of proglottides very variable in shape depending on their situation in the strobila or on maturity degree of the tapeworm. This variability shows in differences in length : width ratio of the proglottides although in any case the width exceeds the length. The ratio is 1 : 10 in newly formed proglottids resp. in young specimens or in hermaphrodites with not developed uterus; it is 1 : 16 in proglottides with well

visible uterus. The above proportions form the limits within which several varieties may be contained.

The shape of the proglottis depends on several factors; population density, and its maturity degree being — to my mind — the most important ones. Maximal proglottis width is 1.2 mm — 0.8 mm on the average. The scolex, collum and some dozens of proglottides form the most narrow part of strobila. The scolex is ovoid in shape (see Fig. 1), 0.182—0.210 mm in length and 0.154—0.214 mm in width. It is provided with four suckers circular or oval in shape; the dimensions of the sucker are 0.051 — 0.015 × 0.061 — —0.095 mm. The short sliding proboscis is armed with ten hooks.

The hooks vary considerably in their shape and dimensions: e. g. they average 0.028—0.032 mm in young *H. furcifera* specimens (the shape is shown on Fig. 2a). They easily fall off during fixation and staining of the tapeworm. The shape and the dimension of the hook changes quite distinctly in older specimens. This shows in handle and guard appearing on the hook now; these new parts differ in colour when stained: the basal part of the hook remains uncoloured while the new ones become light pink when milk acid carmine is used. The edges of the newly growing parts are wrinkled in most cases. The changes in shape and dimension of hooks due to different maturity degrees of the tapeworm are shown in fig. 2 b, c, d, Hook d (Fig. 2), 0.038 mm in length, is typical of specimens with maturing or mature eggs in their strobila particular characteristics of this hook are: a broad handle with wrinkled edges and a deep hollow on the guard. The outward edge of the latter is wrinkled too. Figure 2c shows the most current type of hook. It measures 0.032—0.038 mm and is characterized by the hollow on the guard being considerably less deep. The fact that some of the hooks are being formed later is corroborated by their different shape in the cysticercoid (J a r e c k a, 1958), and in grown-up specimens (from which the eggs were collected); the cystercoid hooks are similar with those in young *H. furcifera* (see Fig. 2d).

The length of the collum is different in different specimens. Several dozens of proglottides following the collum show no anlage of sexual organs. Only excretion channels can be seen in all the preparations stained with milk acid carmine. First testes appearing are three in number. They are situated between excretion channels, the middle testis disposed somewhat behind the other two thus forming a triangle with a more or less wide angle. The testes

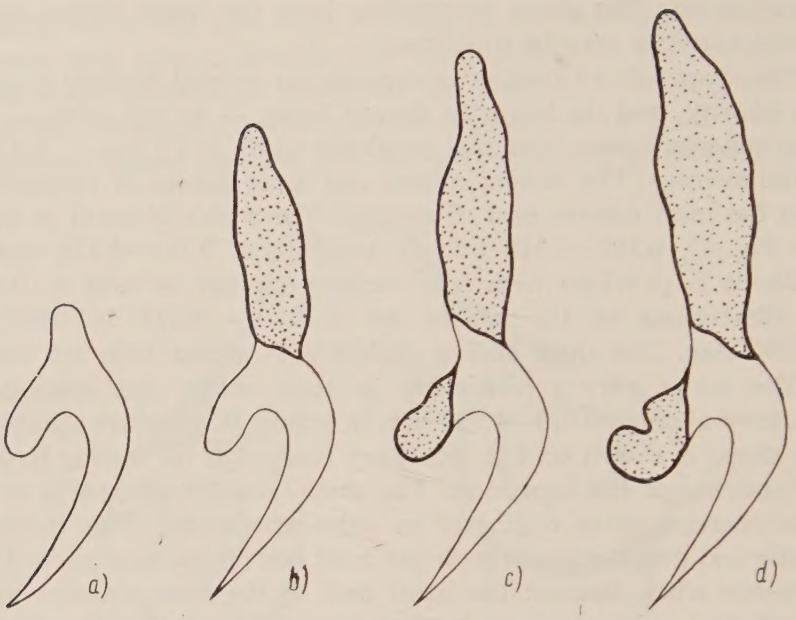

Fig. 2. *H. furcifera* K r a b b e — hook in young specimen (a), and changes in hook shape and length (b — d)

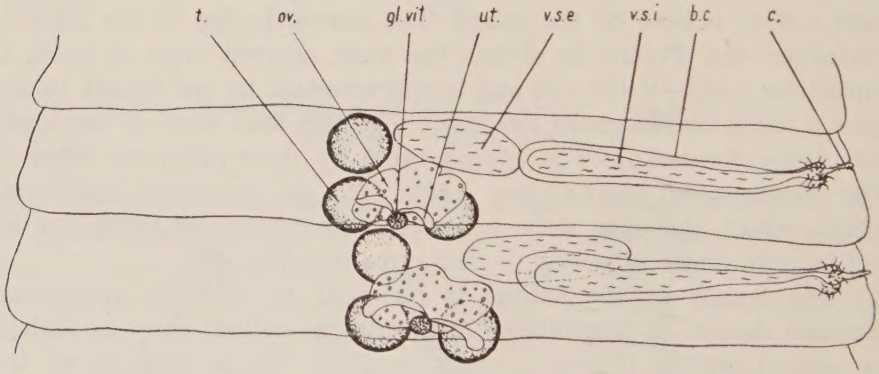

Fig. 3. Hermaphroditic proglottis of *H. furcifera* K r a b b e: b.c. — bursa cirri, c. — cirrus, gl. vit. — glandula vitellina, t. — testis, ut. — uterus, v. s. e. — vesicula seminalis externa, v. s. i. — vesicula seminalis interna, ov. — ovarium.

measure 0.056—0.058 × 0.058—0.067 mm in hermaphroditic proglottides. Bursa cirri, well visible and very pulpy, is 0.213—0.243 in length. An accurate definition of the bursa-cirri-length : proglottid-width ratio is very difficult due to considerable variations in the shape of the proglottides; there are specimens with bursa cirri equalling 1/4 of the proglottis width, and even such where it is more than a half of it reaching or even exceeding the first testis. Thus the bursa-cirri-length : proglottis-width ratio can not be considered a constant characteristic typical of a particular species as variations within the same species are too considerable.

Bursa cirri ends in a flatulation. Cirrus, provided with small and very delicate chaetae, is cylindric in shape; the basal part of the former is armed with much larger and better visible chaetae. The dimensions of cirrus reached 0.014—0.021 mm in length and 0.003 in width in my preparations. Vesicula seminalis externa is, in most cases, situated centrally, directly above the second testis. However it may be bent and disposed in parellels with bursa cirri, but will always remain oval in shape.

The disposition of female genital organs is as follows: the centrally situated ovary covers almost entirely the second testis. It consists of three lobes and is situated dorsally from the testes. Vitellarium, spherical in shape, is placed behind the ovary. The uterus forms, at the beginning, two stripes running away from the vitellarium and occupying the space between the excretion channels. It fills up the entire proglottis in grown-up animal. A large receptaculum seminis can be seen too. Sexual orifices are unilateral, well visible and marked by a sliding cirrus.

Position of *H. furcifera* Krabbe.

Wide range of variability in essential characteristics such as shape and dimensions of hooks as well as bursa-cirri-length : proglottid-width ratio within the *H. furcifera* species forced me to focus attention on a fact which, in my opinion, deserves notice and emphasis namely that variability within each particular species touches even the apparently most constant characteristics. This variability depends upon several factors among which environment as well as population density are not the less important ones. There undoubtedly are species with a very small variability range; but still there are others with a very wide one. The latter need parti-

cular accuracy in analysing. The related species should then be analyzed too as some of the former could most probably be recognized as synonyms of species with a wide range of characteristic variations. *H. furcifera* seems to belong to that sort of species. That is why the analyzis of related species: *Hymenolepis podicipina* Szymański 1905, *Hymenolepis „furcigera* Krabbe 1869", — Joyeux et Baer 1950 and *Hymenolepis capillaris* Rudolphi 1810 should be undertaken too. Many common characteristics are typical for all of them and it permitus to suggest their identity. The following table I shows the characteristics taken into account in classifying species of the genus *Hymenolepis:*

1. No doubt occurs to me that sign of equality should be put between species *H. furcigera* and *H. furcigera,* nevertheless I do not consider the name of *H. furcigera* synonymous with *H. furcifera.* The different names might be a result of a missprint which escaped the author's or the editor's notice. Identify of those „species" is cordoborated by hooks being equal in length and shape (according to the author's drawings), as well as by nearly the same head dimensions or bursa cirri length. The bursa-cirri-length : proglottis-width ratio is 1 : 4 in *H. furcigera.* It is the same in many specimens of *H. furcifera.*

2. *H. podicipina* represents an unsufficiently studied species. Szymański who described it in 1905 had in his disposition material in bad state of conservation. The species under discussion should be, to my mind, regarded as synonym of *H. furcifera* regardless of Szymański pointing out to the length of hooks being more considerable in this species. The shape of hooks and the anatomical structure — i.e. the testes disposition, bursa cirri appearance and shape, cirrus appearance and shape, shape of uterus — are however very similar. All this are arguments in favour of the species under discussion being identical with species *H. furcifera;* the more so if we take into consideration that there was no other report during 53 years elapsed since Szymański first gave its description in 1905 while species *H. furcifera* was reported on several occasions in the world and Polish literature.

3. Species *H. capillaris* seems to differ from *H. furcifera* chiefly in hooks length. The hook shape described by Krabbe 1869 however coincides exactly with that of the cysticercoid or of a young *H. furcifera.* The possibility of hooks continuing to grow afterwards in this tapeworm species (likewise as in *H. furcifera)* is backed

Table I

	H. furcifera Krabbe 1869	*H. furcifera* Joyeux et Baer 1936	*H. furcigera* Joyeux et Baer 1950	*H. capillaris* Rudolphi 1810 Krabbe 1869 Joyeux et Baer 1950	*H. podicipina* Szymański 1905	*H. furcifera* Korpaczewska 1958
Haed dimensions	0.140—0.274 mm av. 0.182 mm	av. 0.160 mm	0.141 mm	0.080—0.180 mm	0.372 mm	0.154 — 0.274 mm
Hook length	0.028 — 0.038 mm	0.026 — 0.033	0.029 — 0.038 mm	R — 0.009—0.012 K — 0.018 ofter Baer J. B. — 0.021 — — 0.022 mm	0.042 — 0.046	0.028 — 0.038 mm
Bursa cirri length	0.202 — 0.244 mm		0.176 — 0.280 mm	0.184—0.225 mm		0.213 — 0.243 mm
Bursa cirri length: proglottis width			1 : 4	1 : 2	1 : 2	1 : 2 1 : 3 1 : 4
Hosts	P. *cristatus* L.	P. *cristatus* L. P. *auritus* Lathr P. *griseigena* Bodd. P. *nigricollis* Brem. P. *ruficollis* Pall.	„Grebes et Plangeons“	P. *auritus* Lathr. P. *arcticus* Braun	P. *auritus* Lathr.	P. *cristatus* L. P. *griseigena* Bodd.
Area of distribution			Switzerland	South Poland	South Poland	Lake Mamry (Poland)

by the fact that different authors are reporting different hook lengths. Bursa cirri length is 0.184—0.225 mm in *H. capillaris* which does not differ much from that of *H. furcifera* (0.202— which does not differ much from that of *H. furcifera* (0.202— *pillaris*. The ratio of bursa-cirri-length : proglottis-width is 1 : 2 in *H. capillaris* i.e. the same as in several specimens of *H. furcifera*. The testes disposition is similar. So is the cirrus, both in shape and dimensions. Differences noted in strobila length (which results in changed proglottides proportions), as well as the slightly differing scolex size may be, in my oppinion, attributed to such factors as: the ultimate host being typical or not, population density, maturity degree of the latter, etc.

Differences arising in such way should be, to my mind, regarded as intra-species variations. Consequently the species *H. capillaris* and *H. podicipina* were created as result of the authors not being acquainted with the variety limits of characteristics in *H. furcifera*. Indeed none of the workers mentioned in the present paper used such abundant material in his study as was in my own disposal.

I therefore consider that *Hymenolepis capillaris* Rudolphi 1810 and *Hymenolepis podicipina* Szymański 1905 must be regarded as synonyms of *Hymenolepis furcifera* Krabbe 1869; the species described by Joyeux et Baer as *H. furcigera* must be recognized as identical with *H. furcifera* assuming the substitution of one letter in the name by an other was due to inadvertency of the author or editor.

Remarks on appearance of *Hymenolepis furcifera* Krabbe 1869

Hymenolepis furcifera Krabbe and *Ligula intestinalis* L. were the only two tapeworm species I have found in the 68 speciemens of *Podiceps cristatus* L. and *Podiceps griseigena* Bodd. studied. The quantity ratio of the two tapeworm species are inversely proportional to each other: the higher is the number of *Ligula* the lower is that of *H. furcifera*.

The length of particular *H. furcifera* specimens diminishes with increasing population size. This is in agreement with Wiśniewski's (1955, 1958) observation on specific regularity according to which every host has a definite capacity favouring normal development of parasites without any major obstacles. Beyond all question

there are certain groups of tapeworms in which the effect of population size causes diverse kinds of reaction. To one of such groups belong the tapeworms in which the effect of increasing population size causes reduced body size but at the same time conditions for normal development still exist. The above characteristics are exactly typical of *Hymenolepis furcifera*. This will be best corroborated by the various dimensions of individual specimens of *H. furcifera* found in two birds: *Podiceps cristatus* No 56 and *P. cristatus* No 167 (see Table II). Bird no 56 was invaded by 17 specimens of *H. furcifera* while bird no 167 contained 43 of them.

Table II

length in cm.	5—10	10—15	15—20	20—25	25—30	30—35	35—40	40—45	45—50	50—55
No 56	—	1	2	1	1	3	3	4	1	1
No 167	1	12	22	5	1	1	—	1	—	—

Less than on twenty occasions the author had fully developed eggs at his disposal during the two year period of study. They were found only very late in summer or in autumn, and on some occasions in spring time. In full summer time however I never met with fully developed specimens although the intensity of invasion was the highest at this period. It therefore might be supposed that this particular species reaches periodically its full development stage. The fact of *H. furcifera* population being very little differentiated during the full summer time speaks in favour of the above supposition too. Specimens found in an individual bird show slight variations of length although the latter vary with population size in different hosts. Neverteless the entire population seems very uniform like the invasion has occured once or, in any case, not more than twice.

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STRESZCZENIE

Tematem pracy jest analiza gatunku *Hymenolepis furcifera* Krabbe 1869 oraz pokrewnych „gatunków": *Hymenolepis „furcigera* 1869" — Joyeux et Baer 1950, *Hymenolepis capillaris* Rudolphi 1810, oraz *Hymenolepis podicipina* Szymański 1905. Analiza oparta jest na dokładnym poznaniu przez autorkę gatunku *H. furcifera* Krabbe, z *Podiceps cristatus* L. i *Podiceps griseigena* Bodd z jeziora Mamry w liczbie 1426 osobników.

Szeroki zakres zmienności istotnych cech, jakimi są między innymi kształt i wielkość haków oraz stosunek zasięgu bursa cirri do szerokości członu w obrębie gatunku *H. furcifera*, upoważnił autorkę do wyciągnięcia następujących wniosków: gatunki *H. capillaris* i *H. podicipina* uznać należy za synonimy *R. furcifera*, gatunek zaś opisany przez Joyeux i Baera (1950) pod nazwą *H. furcigera* uznać za identyczny z *H. furcifera* — traktując błąd polegający na zamianie jednej litery jako przeoczenie autorów lub redakcji.